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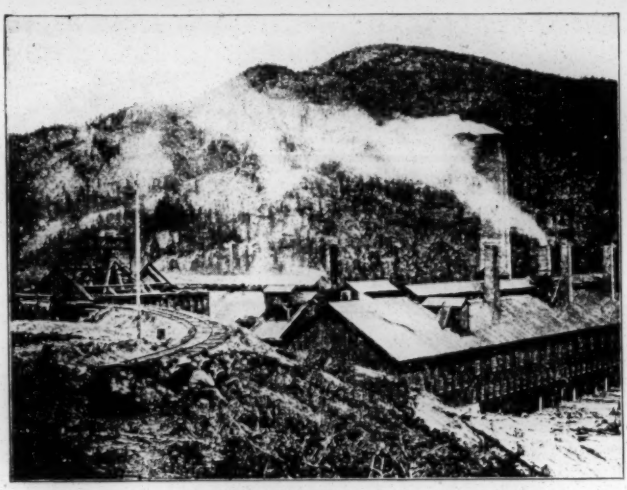

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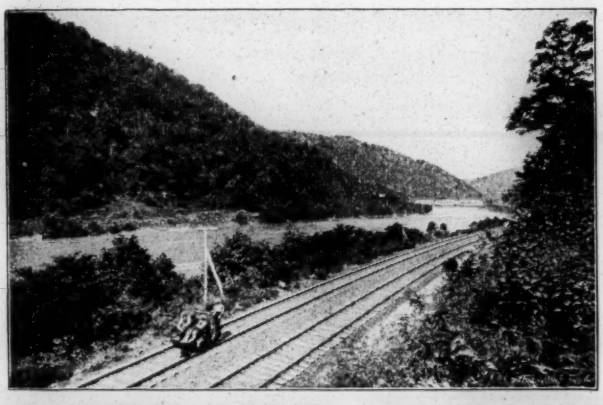

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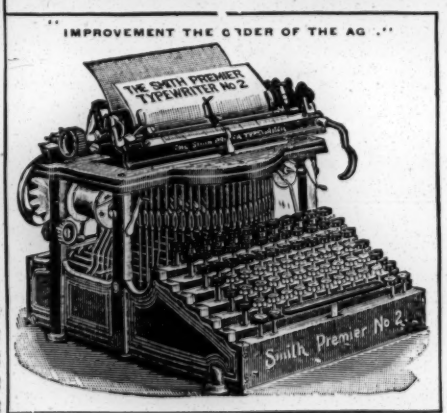

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1					1
2					2
3					3
4					4
5					5
6					6
7					7
8					8
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THE

National Geographic Magazine

VOL. VIII APRIL, 1897 No. 4

A SUMMER VOYAGE TO THE ARCTIC

By G. R. PUTNAM,

United States Coast and Geodetic Survey

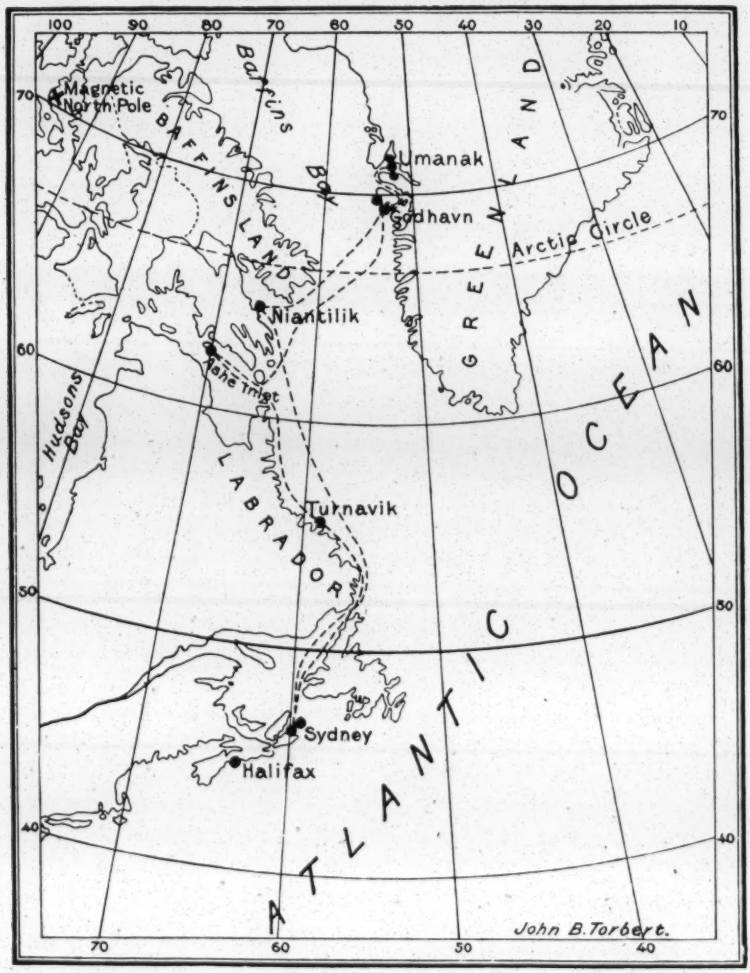
Among the scientific parties that assembled at Sydney, Cape Breton, in July last, for the purpose of paying a brief visit to the Arctic under the leadership of Lieutenant Robert E. Peary, U. S. N., was one organized by Professor A. E. Burton, of the Massachusetts Institute of Technology. Of this party I became a member, having been granted leave of absence by the Superintendent of the Coast and Geodetic Survey, with the use of the necessary instruments to carry on magnetic and pendulum observations. The destination of our party was Umanak fiord, in the northern part of Danish Greenland and several hundred miles within the Arctic circle. This fiord, although of considerable interest, has seldom been visited by exploring expeditions. It is one of the largest on the Greenland coast and contains some of the finest mountain scenery, being the outlet of a group of glaciers of unusual magnitude. It is also the home of the most prosperous of the Greenland Eskimo communities.

Our voyage was but a summer trip to moderate latitudes, devoid of the conventional Arctic hardships; and yet such a trip to Greenland has the peculiar advantage that many of the most striking of Arctic phenomena are either actually encountered or are easily accessible. We sailed from Sydney on July 16 on the steamer *Hope*, under the command of Captain John Bartlett, an experienced Arctic navigator. The *Hope* is one of the best of the Newfoundland sealing and whaling fleet, which is composed of strongly built ships, heavily timbered and sheathed for work in

the ice, and manned by hardy Newfoundland sailors. Our course lay north along the east coast of Cape Breton and the west coast of Newfoundland, and then through the straits of Belle Isle, where on the third day out we saw the first icebergs. From this time on for over two months these Arctic wanderers formed a part of every scene. At first they were a constant source of interest, because of their enormous bulk, their varied outlines, and their beautiful coloring, changing from a marble white to a sky blue or a delicate pink, with an emerald green just below the surface of the water. We amused ourselves by idealizing them, turreted castles, vast amphitheaters, triumphal arches, obelisks, ships, and animals being all represented in the magnificent procession of bergs which we passed. Some which I measured had a height of 160 feet above the water and a length of 800 feet.

Soon after leaving the straits we began to encounter floe-ice, through which we continued to steam for about 700 miles, along the Labrador coast, which we closely followed. This was a great stream of ice brought south by the Labrador current, and consisted of "pans" from a few feet to several hundred feet in diameter, but generally so separated that the steamer could push her way through without difficulty. In places, however, the effect of the wind had been to drive the pans close together, and then our progress was extremely slow, and indeed sometimes the ship was entirely stopped until a change in wind or tide caused the ice to loosen. To break through barriers across our way it was sometimes necessary to back the ship and then go ahead at full speed, using the prow as a ram. The sensation of a ship striking and pushing these ice pans was a little startling at first, but we soon saw what the vessel could stand, so that only an unusual bump, that would rattle the dishes on the table and perhaps throw us off our feet, would cause remark. It took us a long time, however, to become used to the grinding of the ice against the sides of the vessel as we lay in our bunks at night.

While in this ice we had some extremely beautiful effects of the mirage. One day when steaming along with only loose cakes about us we appeared to be surrounded by a perpendicular ice-wall, apparently cutting off all hope of progress, but as we proceeded this phantom ice-wall ever kept at the same distance from us. Near sunset the coloring on this mirage made an especially beautiful sight. We sometimes saw three and even four perfect images of distant icebergs and islands, one suspended above another. Some of these effects were fantastic beyond



ROUTE OF THE "HOPE" AS FAR AS UMANAK, SHOWING MAGNETIC STATIONS

description, frequently changing even while we were gazing on them. Although the ice impeded the progress of the ship, it proved a blessing in disguise to those who were not good sailors, as it had the effect of destroying the ocean swell. Thousands of Newfoundlanders gather on the Labrador coast each summer to fish. Many of their vessels we saw, and at Turnavik, one of their little settlements, we stopped a few hours.

It was while in the ice off Cape Chudleigh that we first saw polar bears in their native habitat. A large white bear and two

cubs were one day seen running over the pans not far distant from the ship, and their curiosity caused them to come nearer and gaze at us. They were nearly the color of the ice and, running nimbly over the pans or swimming rapidly across the water spaces, were a pretty sight. A number of rifles were brought out, and the large bear was killed after a desperate effort to escape. A long chase followed for the cubs, the injunction being to take them alive. They were followed by boats and on foot over the ice and finally were taken. The one captured first was left in charge of one of the Cornell party to hold until the return of the boat. As the cub, although but a few weeks old, would not have been a pleasant companion for one man on a small ice-cake, our comrade, holding to the line about the bear's neck, kept him in the water and at a safe distance with a boat-hook, and the struggles of the bear to get on the ice and of the man to keep him off furnished considerable amusement to those members of the party who remained on the ship. The cubs were finally caged on the deck of the *Hope* and remained our companions during the remainder of the voyage, growing greatly in size but not the least in affection either for their captors or for each other. They may now be seen in the National Zoological Park at Washington.

The scenery along the Labrador coast became more striking as we proceeded northward. It is mostly a rocky, bleak-looking shore, treeless and barren, indented with deep bays and fringed with islands. In the southern portion the topography is low and its rounded outlines give every indication of the smoothing effect of glacial action. Just south of Cape Chudleigh, however, the mountains fringing the shore attain a height of 6,000 feet, and in many cases have sharp, rugged outlines.

Passing into Hudson strait, the *Hope* was soon clear of the ice. After steaming over 200 miles along the north shore, we reached Ashe inlet on July 24. Here and on the mainland opposite two days were spent in exploration and investigation. At Ashe inlet there was located some ten years ago one of a number of meteorological stations established by the Canadian government for the study of the Hudson bay and strait climate in connection with the practicability of regular navigation in this region. A portion of the frame house was found standing, and it was the only sign of human habitation, with the exception of a few traces of Eskimo encampments. A more bleak and desolate-looking region it would be difficult to imagine; where the rock was not bare, the scanty vegetation was not over a few inches high. In

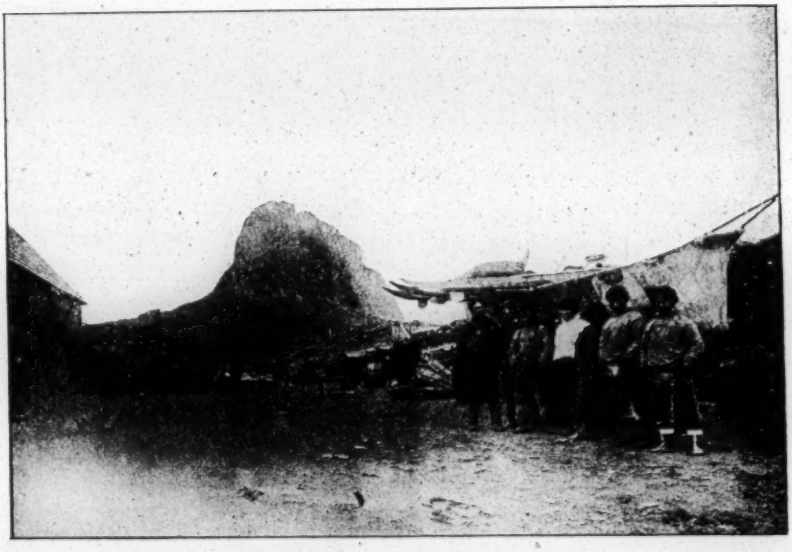
this vicinity one of the ship's anchors was lost, the chain being parted by a moving pan of ice, and a whale-boat was injured by a southeasterly gale driving it on the rocks. There is a tremendous tidal action in Hudson strait, the rise and fall at Ashe inlet being some 30 feet. On this account the strait does not freeze solid in winter, but becomes filled with an enormous ice-pack, which moves back and forth and forms an impenetrable barrier to navigation the greater part of the year.

On the way out of Hudson strait we had our first good view of the Eskimo, although we had seen a few of the race at Turnavik, in Labrador. Our first warning of their approach was a peculiar shrill call, which travels over the water long distances. It was some minutes before the uninitiated could discern the distant specks on the water, which we were told were the Eskimo men in their kayaks. They rapidly approached and were taken on board—boats and all. The kayakers were soon followed by an umiak, or large skin boat, filled with the remainder of the settlement, including women, children, and dogs, as well as nearly all their earthly possessions. Although their wealth seemed very meager, they appeared to be among the happiest of peoples; their round, fat faces simply beamed with good nature. They were very anxious to trade, the objects most highly prized being plugs of tobacco, knives, guns, and copper coins. The last mentioned they took in preference to silver, their only use for either apparently being to sew on to the women's blouses as ornaments. They were dressed in furs, the men and women much alike, except that the women's blouses had a long tail behind and a large hood or sack on the back, in which the baby was carried. Their peculiar appetite was shown by the relish with which they drank the contents of some cans of bear oil which the boys had been saving to grease their shoes with.

After passing out of Hudson strait, an attempt was made to enter Cumberland sound, but the entrance was completely blocked with ice, and our course was shaped for Greenland. In crossing Davis strait we also crossed the Arctic Circle. This event was celebrated by the firing of cannon and the hoisting of flags. Neptune came aboard in the person of one of the sailors, who attempted to shave the uninitiated, using a lather of engine grease, and a ship's scraping iron for a razor.

Our first view of the Greenland coast was obtained near midnight on August 1, the high, ice-capped mountains in the vicinity of Holstenborg forming a beautiful scene in the Arctic twilight.

The following day we landed at Godhavn, the capital of the Danish inspectorate of North Greenland, and were cordially received by the government officials. The interior of the island of Disko, on which Godhavn is situated, is an elevated plateau averaging three or four thousand feet in height and covered with an ice-cap. The passage through the remarkable channel east of Disko, called the Vaigat, was a continual panorama of fine scenery. High mountains rose directly from the water on either side, with glaciers coming down between them and glimpses of the interior ice-cap presenting themselves at intervals. The Vaigat itself was so filled with enormous bergs that the ship had to wind its course among them. Entering Umanak fiord on the night of August 4, a most beautiful Arctic midnight scene was spread out before us. The sun dipped only about two degrees below the horizon at midnight, so that after about an hour of glowing sunset there was bright sunshine again. Lying along the northern border of the fiord were the highest mountains in this part of Greenland, sharp, cragged peaks of over 6,000 feet. To the eastward were groups of mountainous islands, and between them could be seen the smooth, white swell of the great interior ice-cap of Greenland. To the south were the mountains, glaciers, and green foothills of Nugsuak peninsula, and to the



A SETTLEMENT ON UMANAK FIORD

west stretched the open water of Baffin bay, while all around were the stately icebergs proceeding from the great glaciers at the head of the fiord.

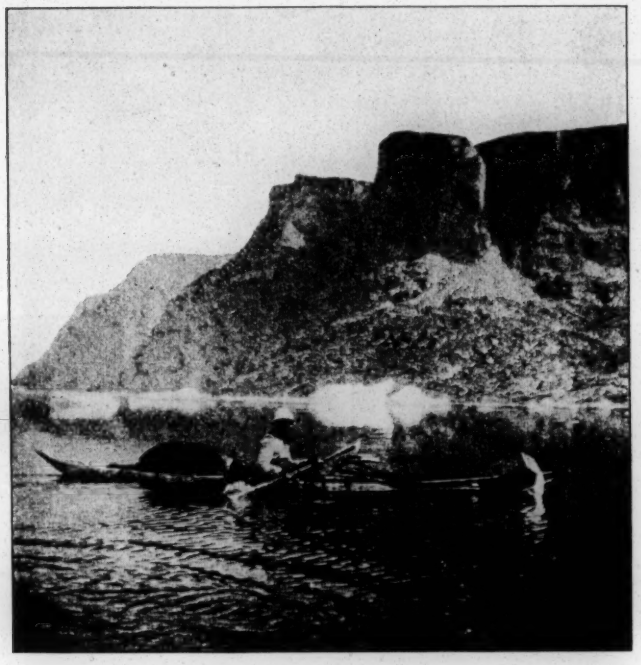
The *Hope* left our party at Umanak, the principal settlement of the district, which was to be our headquarters for several weeks, and where the vessel was again to return for us after its trip further north. The village is situated on an island, which though only about three miles in length, has in its center a mountain nearly 4,000 feet in height, a most remarkable shaft of rock, from which the name Umanak, being the Eskimo for "heart-shaped," is derived. The village consists of about 150 Eskimos and three Danish families. We found these Danish officials and their families most intelligent and hospitable people. They are almost entirely cut off from the rest of the world, only receiving news from Europe two or three times during the short summer. During ten months they are completely isolated, and for two months they do not see the sun.

In the management of their possessions in Greenland and of the native races, the Danes have followed a plan unique in the world's history. Between Cape Farewell and Upernivik, said to be the most northern civilized settlement in the world, there live about 10,000 Eskimos, scattered in villages along the coast. They are divided into twelve districts, of which Umanak is commercially the most important. In each district there are usually a governor, an assistant governor, having charge of commercial affairs, and a Lutheran pastor, in care of religious and educational matters, but beyond these and a few minor officials in charge of subsettlements, no Danes or other foreigners are allowed to settle in Greenland. The whole is under the direction of the Royal Greenland Board of Trade, a government bureau in Copenhagen which has a monopoly of the trade of Greenland. Supplies are sent out annually in nine ships, which bring back the products of the region to Denmark. European goods are furnished to the Eskimos at but a slight advance over cost price, and they are paid amounts fixed in advance, once in five years, for the furs, oil, ivory, etc., which they bring in. All other trade along this coast is prohibited, and vessels are not allowed to even enter the Greenland ports, except by special permission or in distress. The idea has been to protect the natives in their rights and pursuits as well as in their morals. The arrangement is not a profitable one to the Danish government, the loss on the Greenland trade during recent years being said to have been as much as

$100,000 annually. Almost every village is provided with a church and a school, and the language taught is not the Danish, but that spoken by the natives themselves. The great majority of the Eskimos can read and write and are nominally, if not actually, christianized. Such a policy could hardly have been carried out in any region less isolated than Greenland. Whether or not their contact with civilization has been beneficial to the Greenlanders, it is probable that the continuance of the Danish system is their only salvation, for if the Danes were to withdraw, the wealth of this region in fisheries and hunting would soon attract a population that would so far interfere with the life and pursuits of the Eskimos as to cause their early extinction.

These Greenland Eskimos, although they have been in contact with civilization for 250 years and are largely intermixed with foreign blood, have retained many of their original modes of life. The more pure-blooded are an intelligent-looking people, with smooth, round features and frank, open countenances; they are short in stature and have straight, black hair. They ordinarily live in flat-roofed houses, built of rocks and turf, often containing but a single room, with a sleeping-bench at one end and a long, low entrance for keeping out the cold in winter. In summer they often live in tents, moving from place to place. They

A GREENLAND FAMILY



KAYAKER IN UMANAK FIORD

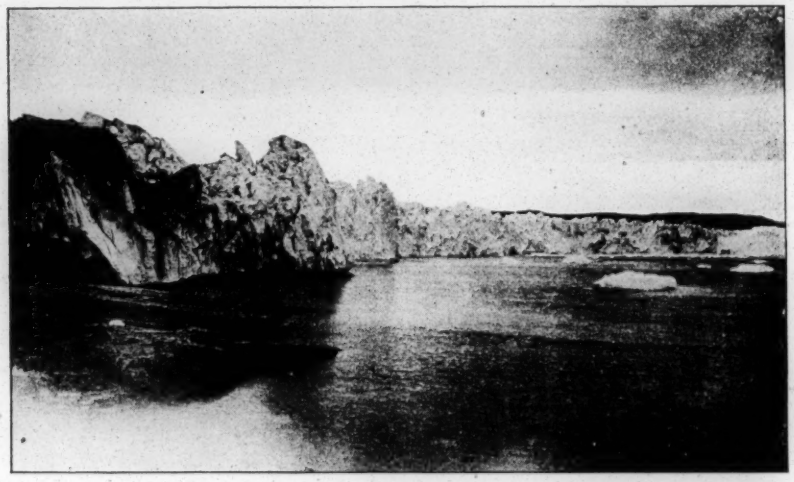
hunt the seal, walrus, narwhal, reindeer, bear, and smaller game—birds and fish—with which the region is stocked. By far the most important of these, to them, is the hair-seal, called by them "puisse," many varieties of which are found on this coast. The skin is used for clothing, boat covering, and tents, the blubber for fuel and illuminating oil, and the flesh for food. The highest ambition of a young Eskimo is to become a successful seal-catcher. For this pursuit they have developed some of the most ingenious appliances ever invented by a primitive people. In the summer they use the kayak, a skin boat which is a model of ingenuity, lightness, and gracefulness. With these small, frail boats, sometimes not over 18 inches wide, they do not hesitate to go out into open water and to attack large animals, such as the seal or walrus. The more expert can perform remarkable feats, the most astonishing of which is for the kayaker to turn completely over, boat and all, and right himself again without getting out of the kayak, and without getting a drop of water into it. He wears a waterproof shirt tied closely about the small

opening in the deck in which he sits, and rights himself with a dexterous use of his double-bladed paddle. In addition to the rifle, which is now generally used, his main weapon is a harpoon having a detachable point which remains in the seal after it is struck. Attached to this point by a long line is an air-bag, which floats on the surface, and enables the kayaker to follow the seal in its struggles. In winter the northern Greenlander depends on his dogs and sled for transportation. The Eskimo dogs are his only domestic animals, and every village is filled with them. On smooth ice great distances can be traversed in a single day, speeds of 16 miles an hour being attained. In Umanak fiord the sledging lasts more than half the year, the season in 1896 not ending until July.

The Eskimos are a childlike, gentle race. They are honest and remarkably free from brawls and disputes. Jails and constables are entirely lacking in Danish Greenland. The very simple local affairs are regulated by district councils, composed of the leading natives and the Danish officials, who meet twice a year. The language is most peculiar and difficult for a stranger to master. It is composed almost entirely of nouns and verbs, and by suffixes and affixes to these the other parts of speech are formed. It is possible to express the meaning of a long English sentence in a single word, but some of these are forty letters in length. The investigations of Rink have shown that the more familiar words are common to all the Eskimo peoples, thus proving their common origin. He estimates that there are about 30,000 Eskimos, of whom one-third live in Danish Greenland, one-third in Alaska, and the remainder in northeastern Siberia, the northern portions of North America, and a few in Greenland beyond the Danish dominions.

From Umanak several trips were made in small boats to the great glaciers at the head of the fiord. The largest of these is the Karajak. The face of this glacier, from which the bergs break off into salt water, has a width of about four miles, a height above the water of over 250 feet, and in the center moves with a velocity of from 20 to 35 feet per day. A single iceberg breaking off from this glacier has been estimated to contain 24 million cubic yards of ice. At the price usually paid for ice for domestic purposes in the United States, the ice in such a berg as this would be worth over $100,000,000. At another glacier, the Itivdliarsuk, we saw a great mass, 300 feet long, break from the face; the crashing and thundering noise that resulted, the surging of

the berg until it found its equilibrium in the water, and the dashing of the waves on the beach, with spray in places 100 feet high or more, made an impressive scene. In the narrower fiords the calving of a large berg will sometimes cause a tidal swell that will raise the water 20 feet. The surface of a glacier near its front is usually a mass of jagged pinnacles with deep crevasses between. Looking up the slope of the great ice-river the surface becomes smoother, and finally back on the distant horizon one sees the apparently smooth white plain of the ice-cap. A climb to the summit of a 3,000-foot mountain near the Itivdliarsuk glacier gave us some idea of this great ice-cap and the glacial

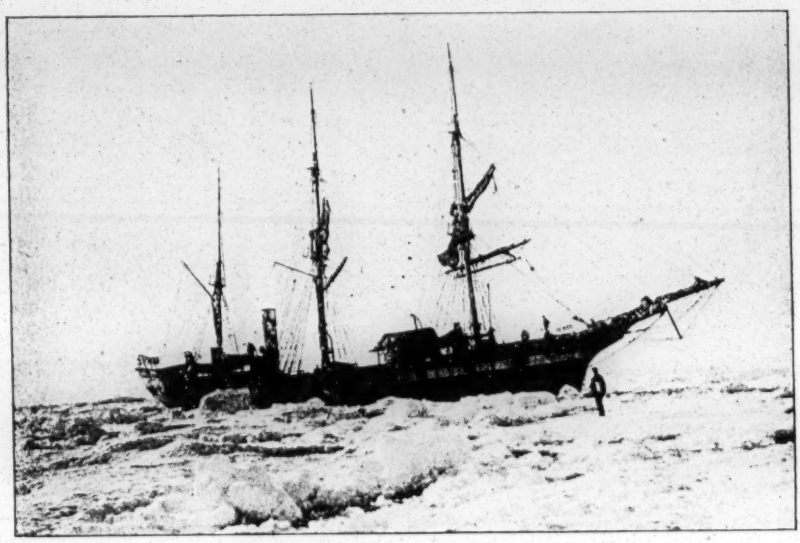


FACE OF ITIVDLIARSUK GLACIER

work along its edge. As far as the eye could reach to the north, south, and east extended this smooth, white field of ice sloping up from the seacoast and with an horizon line as level as that of the ocean. At regular intervals along its edge could be seen the crevassing at the heads of the glaciers, which were themselves cut off from view by the intervening mountains. At our feet the course of the ice-river was spread out before us, winding through the mountain valleys and around the nunataks or peaks projecting through the ice, from each of which it drew out a long moraine of rock debris. The interior ice-sheet covers the whole of Greenland with the exception of a narrow fringe along the coast. It rises to elevations of from 8,000 to 10,000 feet in the

center, and the enormous pressure of the accumulating snow presses out the glaciers through every opening in the bordering mountains. That this ice-sheet was once more extensive than it is now is proved by the rounded outlines and glacial scratches found on nearly all the coast mountains. On the other hand, the climate of Greenland must at one time have been very much warmer. In the vicinity of Umanak fiord coal deposits are found and fossils of such semi-tropical trees as the fig and magnolia.

Notwithstanding the nearness of the ice-cap, the present climate of Greenland is much milder than that of the opposite side of Davis strait. In the fiords the summer climate is moderate and



THE "HOPE" IN THE ICE OFF CAPE MERCY

pleasant; we found light winter clothing comfortable, but nothing more was needed. Wherever there is soil, there is an abundance of wild flowers and grasses, but we found no trees. A curious meteorological fact is that the Föhn wind, which blows directly off the ice-cap, always brings the warmest weather; the usual explanation being that this heating of the wind is due to its sudden descent from the elevated interior to the low coast.

The *Hope* called for us at Umanak on September 9, and our homeward voyage followed much the same course as our outward one. The only severe storm we encountered was in crossing Davis strait. Off Cape Mercy the *Hope* was caught in an

ice-pack, in which she was held for three days. With a change of wind the ice loosened and the ship was slowly extricated, reaching open water in Cumberland sound. Two days were spent in the vicinity of Blacklead island. This is a Scotch whaling station, and the settlement consists of three or four Europeans and a large number of Eskimos. The system obtaining here is a sort of feudal one, without government control. The natives work for the management, in return for which they receive European supplies, no money being used. From this point two passengers were brought back to America, one an English missionary, who had been working among the Eskimos, and the other a Dane, who had charge of an American whaling station farther south. The latter brought with him the whalebone taken from a single whale, the whalebone weighing something over a ton and being valued at more than $10,000. Both of these men, who had spent years in this bleak, cold country, expressed regret at leaving it and the hope of soon returning.

The voyage from Cumberland sound was without incident, save some beautiful auroral displays at night, and we landed at

CUMBERLAND SOUND ESKIMOS

Sydney on September 26, all the 48 persons constituting the passengers and crew returning well and without accident.

Some investigations in two lines of terrestrial physics were carried out by the writer in connection with the work of Professor Burton's party. At each of the stopping places where time permitted, magnetic observations were made, determining the deviation of the compass needle from true north, the dip of the dipping needle, and the force of the earth's magnetism. Two of the stations were near enough to the magnetic North Pole of the earth to cause the dipping needle to stand within six degrees of the vertical. The Greenland stations were so well to the east of the magnetic pole that the compass needle pointed more nearly west than north. The horizontal magnetic force in these regions is very weak on account of the great dip, so that magnetic disturbances caused considerable changes in the needle, a change of over four degrees being noted in a single day at one point. For the same reason the ship's compasses were irregular. A comparison of these results with earlier magnetic observations made in these regions clearly indicates the direction of change at present going on. At all the stations from Halifax, Nova Scotia, to Umanak, Greenland, the westerly declination, the dip, and the total magnetic force are all diminishing. At several points also pendulum observations for the measurement of the force of gravity were made. This force increases from the equator to the poles, and, following the theorem of the French mathematician, Clairaut, the amount of flattening at the poles of the earth may be computed by comparing the force of gravity at different latitudes. By a well-known law, the time of oscillation of a pendulum will be proportional to the square root of the force of gravity; so that by comparing the time of oscillation of the same pendulum at different places the relation of the force of gravity may be obtained. Comparatively few such observations have been made in high latitudes, where they have great weight in the problem of the figure of the earth.

[The illustrations accompanying the foregoing article are from photographs by Professor A. E. Burton and other members of the party.]

AREA AND DRAINAGE BASIN OF LAKE SUPERIOR

By Dr Mark W. Harrington,

President of the University of the State of Washington

Lake Superior is the largest and one of the deepest, not only of the Great Lakes of the St Lawrence basin, but of all the bodies of fresh water on the earth, and it possesses some other remarkable characteristics of its own; yet, though it has been so long known that it was roughly mapped 250 years ago under its present name, and charted several times with fair accuracy in details for the time before the end of the 17th century, and though it was charted with minute accuracy by the United States engineers 30 years ago, there has even yet been but little discussion of its more interesting and peculiar features. This is all the more remarkable because its extraordinary wealth in minerals and fish has been recognized from the beginning and has for half a century formed an important item of our national wealth and commerce, and more recent developments have shown agricultural possibilities which are by no means contemptible. It is the purpose of this paper to call attention to some of the peculiar and noteworthy features of the lake, more especially those which relate to its climate and weather and have a bearing on its commerce and agriculture.

The statistics of Lake Superior, as to coast line and area, vary so much in geographic publications that I have had new measurements made with a planimeter by Mr R. F. De Grain, of the Weather Bureau, the coast line being carefully meandered. The following are the results:

Coast Line

On American side	880 miles.
On Canadian side	992 "
Total coast line	1,872 miles.

Areas of Lake Superior

Total, including all bays and islands		32,166 square miles.
Deduct islands:		
Isle Royal	223 square miles.	
St Ignace	112 "	
Michipicoten	83 "	
Simpson	36 "	
Grand	26 "	
Pie	22 "	
Slate	14 "	
Copper	12 "	
Apostle islands	82 "	
Total		* 660 square miles.
Total water surface		31,506 square miles.

It is customary on the lake to look on certain nearly inclosed bays as distinct from the lake. Deducting these:

Whitefish bay	353 square miles.	
Nipigon bay	310 "	
Black bay	213 "	
Thunder bay	165 "	
Total area of bays		1,041 square miles.
Resulting open-lake water surface		30,465 square miles.

Of the 32,166 square miles of the total surface of the lake, there are on the American side 23,359 square miles and on the Canadian side 8,807 square miles.

The boundary line across the lake between the Dominion and the United States is 289 miles long.

With a surface area of 32,166 square miles, Lake Superior is the largest lake in the world. Next comes probably Victoria Nyanza or Ukerewe, in equatorial Africa, with an estimated area of 25,000 to 30,000 square miles. Lake Superior is a half larger than Lake Michigan (22,000 square miles) or Lake Huron (24,000 square miles) and nearly twice as large as Lake Erie (10,000 square miles) and Lake Ontario (7,000 square miles) combined. The combined area of the Great Lakes of the St Lawrence as given by Schermerhorn† is 95,275 square miles, and a third of this is formed by Lake Superior.

*Including 50 square miles for smaller islands not enumerated.

†L. Y. Schermerhorn: Am. Jour. of Science, 3d series, vol. xxxiii, 1887, p. 278.

Of the islands the largest and most remarkable is the one to which the early Jesuit visitors gave the name of Isle Royale, or Regal island. As seen from the north shore, it appeared to the natives like a sleeping Manitou lying prone, but for some reason unknown they chose to consider it an evil spirit and called it *Windigo*. The natives never ventured on the island, and I was told in the summer of 1894 that they are still very loth to do so. Judging by the amount of money which has been expended on it within the last half century, with no adequate return, it has proved a "hoodoo" island to the whites also. Copper indications abound, and so, also, do the deserted shafts and drifts where somebody has tried following a vein or reaching it from one side. Probably a million and a half or two million dollars have been expended in mining on Isle Royal with inappreciable return. The chlorastrolites or greenstones of Isle Royal have probably given and may continue to give more income than the copper. The island consists of a series of ridges running parallel to its length, reaching at times a height of 400 or 500 feet above the lake, generally smoothed and rounded on top, terminating to the northeast in the most interesting illustration of fiord structures to be found on the continent. Finger-shaped alternations of slender bays and equally slender peninsulas, the latter extending or breaking up into parallel lines of islands, afford a complex of land and water, the former steep and rocky, but generally covered with a dense growth of dark green spruce and fir trees, the latter very deep, very blue, and very clear, the whole very picturesque in bright weather, but extremely confusing when the weather is smoky or foggy. The population of the island is generally small and never permanent. It belongs to Michigan and brings the western point of this state only 12 miles from the eastern point of Minnesota. It was at one time a county by itself, but there were not enough permanent residents to fill the offices, and it was attached to Houghton county of the mainland. It has no post-office. There is abundant water, the soil is excellent, though small in quantity, and the usual vegetables and cereals can be raised. The native animals on the island included nothing larger than the lynx or wild-cat until a few years ago, when a small drove of caribou came over on the ice from the north shore. The passage between Isle Royal and the north shore, though only 12 to 18 miles broad, has so deep water and so strong currents that it does not long remain frozen, and the caribou still remain on the island, where, not being hunted, they

had become in 1894 a drove of a score or more and were quite tame. They are said to be sometimes found standing and looking with longing eyes toward the north shore, as if anxious to return to their fellows, with the expanse of the continent before them. The very deep soundings which can be made on all sides of Isle Royal and almost off its banks and the form and surface of the island show that it is an isolated and nearly submerged mountain ridge, rising from 1,000 to 1,500 feet from the bottom of the lake. It is the only island of this sort in the Great Lakes, and for its parallel we must look to the isolated and volcanic islands of the great oceans.

The island next in size is St Ignace, or, with Anglo-Saxon love of brevity, simply Ignace. It is one of the series of islands which close the three great bays (Thunder, Black, and Nipigon) of the extreme north of the lake, and with the projecting ends of the two peninsulas between these bays they form a remarkable series of escarpments extending from Pigeon river on the west nearly to Slate islands on the east, all belonging to Ontario. Beginning at the west, the first great island, and the "stopper" to Thunder bay, is Pie island, so named from its resemblance to a British pie—a structure which has a much greater altitude than its American namesake. This island has an area of 22 square miles, and consists of two tabled hills or mountains separated by a large space so low as to make the tables appear to be separate islands. The western or smaller table is 850 feet above sea-level. Its escarpments are very abrupt on all sides, and the top is nearly inaccessible. On it, however, is a large pond or small lake without outlet, but stocked with brook-trout. The other table, the "pie" proper, is much larger, but only 700 feet high and relatively accessible. Next, going eastward, is Thunder cape, the extreme point of the peninsula between Thunder bay and Black bay, precipitous and rising directly from the lake to an elevation of 1,250 feet from its surface. It is the highest point immediately on Lake Superior, and is of tabular form. The precipitous sides are carved into curious forms, especially on the west side, and are bare of trees. The assumed daily thunder about this point in summer is the alleged origin of the name of the cape as well as of the bay over which it stands sentinel. The "stopper" for Black bay is Edward island (6 square miles), and Nipigon bay is closed by St Ignace, Simpson (or Sampson), and Copper islands in their order from west to east. These islands are very similar in general characteristics, and a description of St Ignace will

apply to all. It is of a general quadrangular form and is separated from the peninsula to the west and Simpson to the east by narrow rivers or fiord-like straits only a mile or so broad, though many miles long, and several to many fathoms deep. Like the preceding, it is of basaltic character, but the tabular formation so abundantly represented about Thunder bay is here modified by lower altitudes and by rounded hills, which replace the flat surface. On St Ignace island the highest hill attains an elevation of about 850 feet.

In Lake Superior there is but one archipelago proper—that is, a cluster of islands in which no one greatly surpasses all the others. This is the archipelago of the Apostle islands, or, more briefly, "The Apostles," so called by the early Jesuit Fathers, because there were twelve principal islands. The individual islands, however, have received anything but apostolic names, being, in order of size, Madeline (23 square miles), Stockton (16 square miles), Outer (12), Oak (8), Sand (4), Bear, Basswood, and Michigan (each 3 square miles), Rocky, Otter, Manitou, and Cat (each 2 square miles). Then comes the thirteenth apostle, or Devil's island; then the south and north Twins. The total area of the archipelago is eighty-two square miles. The larger of these islands are somewhat hilly and are covered with spruce trees of some size. The smaller are sandy and level. They were settled early in the history of the colonization of the lake, but the population has since dwindled until it is almost *nil*. There is no post-office on the islands.

The drainage basin of Lake Superior is relatively small. Its outlines have not been so definitely mapped that it can be measured with the same accuracy as that of the lake surface, but the total area may be put at 82,800 square miles.* Of this the area of the lake itself makes 39 per cent, and of the land 39 per cent is Canadian and 22 per cent American. The margin of the watershed is low in all directions, and it is in general ill-defined. Along it, throughout almost its entire length, are found innumerable small bodies of water, isolated and without drainage, except at seasons of high water, showing that this watershed is indefinite. The lowest points of the watershed are on the southeast, near the St Marys river, where it reaches but a few score feet above the lake. It gradually rises toward the west, and at a point about fifty miles southeast of Marquette first reaches an altitude of 400 feet above the lake surface. South of Keweenaw

* Schermerhorn, l. c.

point it reaches 900 or 1,000 feet and continues at this elevation to the mountains of northeast Minnesota with so slight fall in either direction that it forms a distinct area of independent lakes, generally small in size, but extremely numerous, both in northern Wisconsin and northern Minnesota. The separation of the waters of the St Louis and the Mississippi where they come closest together is but a few feet. The highest known point of the watershed is in the Mesabi mountains in northeastern Minnesota, where it reaches 1,500 feet above the lake, and isolated points are higher. To the north of the lake the watershed is more distant from the lake and not so well known. The topographic features on the south side are low-rolling and well rounded. On the northwest they are sharper, but still preserve the ordinary mountain form, though sharply serrated. This is especially true of the regular indentations of the "Sawtooth mountains," which follow the northwest shore of the lake and in some places form the watershed. As soon as the Canadian border is passed in the west, the escarpment structure becomes marked—that is, an elevated plateau, relatively flat. Through this the streams have cut down 500 or even 1,000 feet, forming a broad, level valley or narrow ravine, but leaving generally nearly vertical walls. This structure is very characteristic of the Thunder bay region and extends eastward to the Nipigon valley, but farther eastward it appears to run out, until to the east of Lake Superior the basin is similar in topography and vegetation to that about the river St Mary. The drainage area on the south shore is narrow, often not more than 20 miles wide, and seldom more than twice that. The tributaries to the lake are here very numerous but small. There are about fourscore that are 20 miles or more long, but few of them exceed 50 miles. They usually descend rapidly from their source to the lake. In some cases, as in that of the streams at the Pictured Rocks, they have a considerable fall at or near the shore, and the streams that enter at the same level as the lake are usually barred by the combined action of their sediment and the waves. The longest stream on the south shore is the Ontonagon, which enters at Ontonagon, and has a length of 100 miles, with a basin of 250 square miles.

At the extreme western angle of the lake enters the St Louis river, considered the mother-stream of the lake and the source of the St Lawrence. It is 200 miles long and has a basin containing 4,370 square miles. The basin adjoins the remarkable

lacustrine region of Rainy lake, from which it is separated toward the east by the Iron or Mesabi range. Elsewhere its separation from this region, and in the west and south from the basin of the upper Mississippi, is low and ill-defined, characterized by the presence of lakes, ponds, and swamps. Its source is in Otter lake, 30 miles from the northwest shore of Lake Superior and 1,650 feet above sea-level, or 1,050 feet above the lake surface. It flows southwest until about 25 miles from the Mississippi river, when it turns sharply southeast, soon descends nearly all its 1,050 feet of fall, and enters Lake Superior through a long estuary. Its minimum flow of water is *nil*, for it is sometimes frozen solid. Its average contribution to the lake is estimated by Greenleaf* at 1,242 cubic feet per second, but it is probably considerably larger. The rapids are at the Dalles, below the mouth of its tributary, the Cloquet, and but a few miles above Duluth. The presence of a considerable stream with a large fall within a short distance of two such prosperous towns as Superior and Duluth, has suggested to enterprisng engineers the scheme of damming the St Louis above the Dalles and bringing its waters to these cities under a head of 650 feet, as an enormous source of cheap power. Ex-Representative M. R. Baldwin, of that Congressional district, makes the following report on this plan:

"This company has discovered that by putting a dam just above Cloquet it can make a reservoir which will not only be the largest in the world, but will lie entirely within the bluffs of the natural streams; that from the level to which the river will be raised by the proposed dam the water can be taken in a straight line through a canal or pipe, only twelve miles long, to the bluffs back of Duluth, at an elevation of 650 feet above Lake Superior, and that by the storage in this great reservoir of the flood waters, which now go to waste, a supply of water will be available for use under that head, which will create the greatest water-power in the world."

One curious difficulty is found in the fact that if the dam is made too high the reservoir will empty into the Mississippi river and thus contribute to the water-power of Minneapolis instead of to that of Duluth.

Reference has been made to the estuary at the mouth of the St Louis. This has so many features of interest that it deserves a fuller treatment than space will here permit. Suffice it to say, that Lake Superior has been robbed of the extremity of her horn by the combined action of the water of the river and the waves of the

* Report on the Water-Power of the Northwest; Census of 1880, vol. xvii, p. 73.

lake. Formerly the lake extended up to Fond du Lac, so named because the fact of the termination of the lake here was recognized when the settlement was first established. From here to Duluth is eight miles and to Superior City seven miles. From Duluth to Superior is five miles. The triangle thus inclosed by sides of seven, eight, and five miles is the area of which the lake has been robbed. All this has been done within times geologically recent, but before settlements were made, and the later stages of the operation are still in progress.

Lake Superior has not submitted tamely to this highway robbery. She has resisted it continually, and at several points the topography shows that her resistance was successful in staying for a time the progress of the encroachment. The operation is this: Along the line where the motion of the current is stayed by the contact with the lake water a sandbar is formed and the waves soon develop this into a bar rising above the surface, stretching in an easy curve from one side of the bay to the other, thus making an inner bay separate from the lake. The sediment of the river then proceeds to fill up this bay until it is dry land, with possibly a little lake or two left behind. When this is completed the current is again directed into the lake, another sandbar is formed, the whole process is repeated, and the river has encroached another step. Three such steps are easily recognized by the topography, and the fourth is made probable. The fourth is the earliest, and the remnant is found in Spirit lake. The next in order of time is represented by Grassy point, the next by Rices point, and the latest by Minnesota point.

It will be interesting to go into detail for the last, now in progress of development. The bar in this case is called Minnesota point; it is about five miles long, is from 200 to 1,200 feet wide, and sweeps in a free curve from the Minnesota to the Wisconsin shore. It is interrupted for the passage of the river close to the Wisconsin shore. Its average height is 12 to 15 feet, but toward the Wisconsin side the wind has built up a pyramid of from 20 to 25 feet above the surface of the water. It is made of sand and gravel, is covered with small trees and brush, and is a favorite picnic ground for the citizens of Duluth. Behind it is Superior bay, about five miles long and one mile wide, and this is the bay which the river is now filling up. To keep it available for commerce requires the constant efforts of the engineers.

In order to make accessible to commerce the several interior bays of Duluth, a canal 300 feet wide was cut through Minne-

sota point at the Duluth end. The port of Superior is entered by the natural outlet—the passage maintained by the river. When the canal was cut by Duluth, in order that this city might not obtain too great an advantage over its rival, Superior had a dyke erected across Superior bay, on the Duluth side of the mouth of the river. It was expected that the river would not waste its energies on the interests of Duluth, but proceed to scour out the channel for Superior. With that freakiness so characteristic of rivers (perhaps the occasion of our personifying them as "she"), the stream did what was unexpected and proceeded to fill up the Superior channel. Shortly thereafter the dyke disappeared on a dark night by the aid of explosives.

The northwest shore, from the St Louis to Thunder bay, is very abrupt and rocky, backed for about half its length by the "Sawtooth" or "Devil's Tracks" mountains. Along this coast, a distance of 200 miles, there are only a dozen streams that deserve any better name than creek. These drain a strip along the coast only a few miles wide, while behind them comes the basin of the St Louis or that of the Rainy lake district. These streams are all so small that the heavy surf of the coast succeeds in damming their mouths with lofty beaches through which the water seeps. Into Thunder bay enters the beautiful Kaministiquia, 150 miles long, with a basin of 750 square miles. It is a picturesque stream, well known to the French voyageurs, for whom it was the usual route from Lake Superior to Winnipeg in the good old times of the undisputed sway of the fur companies. In its lower course about Fort William, its deep brown waters flow lazily through a broad, flat, low delta which is still growing and which is bounded by distant escarpments of flat-topped mountains. Higher up it has numerous rapids, and few streams along which it was the fate of the hardy voyageur to labor are marked by more numerous portages. The sources are in Lac des Isles and Muskeg lake, from the latter of which it passes as the unpretentious Dog river until Dog lake is reached. It is only below this lake that it receives the harmonious name of Kaministiquia, meaning "that which goes far around."

At the head of Nipigon bay and at the extreme northernmost point of Lake Superior enters the Nipigon river, for which the claim is sometimes seriously made that it is the mother stream of the St Lawrence system. The claim is based on the fact that this stream is the outlet of Nipigon lake, just as the St Marys is of Lake Superior, and that the Great Lakes consist not of five or

of six (when St Clair is included), but of seven, and Nipigon is the seventh and most distant. Nipigon lake is about 40 miles north of Lake Superior and is 850 feet above sea-level. Nipigon river, about 50 miles long, has therefore a fall of 250 feet. It is a picturesque stream, full of rapids and full of fish. The bay, stream, and lake which bear the name of Nipigon (meaning "dirty water") are said to furnish the best fishing in the Lake Superior basin. Lake Nipigon is oval in form, about 60 miles long, north and south, and 50 miles broad, with a surface area of 2,900 square miles. Its coasts are very much indented, and it contains several hundred islands and islets. The greatest depth so far reported is 540 feet, which would bring its bottom below that of Lake Erie, and only 310 feet above sea-level. The erosion at the outlet is strong, and the fall is reported to be wearing away at the rate of 10 feet per century, in which case Lake Nipigon will at no very distant day dwindle to more modest proportions. The lake occupies a small drainage basin, the land area of which hardly surpasses the water area. Its principal feeder is the Ombalika river, which rises in Summit lake, 40 or 50 miles to the north of Lake Nipigon. This lake is said to lie on the "Height of Land" or watershed between Hudson bay and the St Lawrence basin, and its waters are reputed to flow both ways, part into Nipigon and part, by way of the Albany river, into James bay.

There are several other streams on the north shore which are 100 miles or more long, namely, the Pic, the White, and the Magpie, while the Michipicoten does not fall far below this length. The last mentioned was well known to the voyageurs, as it was a part of the regular route from Lake Superior to James bay. At its mouth was the Michipicoten house, which, with Fort William, on Thunder bay, formed trading centers on the north shore a century or more ago, when the western states were an almost unbroken wilderness. Indeed, the north shore of Lake Superior echoed to the busy hum of a considerable commerce a century before the south shore began to attract attention. The history of these two old stations of the Hudson's Bay Company goes back to a time so distant that Agassiz's visit to Lake Superior in 1848 is relatively a recent event.

THE SIBERIAN TRANSCONTINENTAL RAILROAD

By General A. W. Greely,

Chief Signal Officer, United States Army

Recent advices from the East point to the early completion of the great Siberian railroad, which will be the next strong link to bind indissolubly together the commercial interests of the world. It therefore seems an opportune moment to present to the readers of The National Geographic Magazine a résumé of the advices lately forwarded to the Department of State by our consular officials, Messrs Karel, Monaghan, and Stephan.

The Russian budget for 1897 assigns 65,000,000 rubles to the continuation of the Trans-Siberian railway, and its opening will be an event scarcely less important than the completion of the Suez canal. Five thousand miles of steel rails have been laid already at a cost of 350,000,000 rubles, and in 1898 trains are to run to the Amur river. Passengers, post parcels, and freight will be pushed on by fast steamer to Chaborowka, and thence over the South Russian section of the Siberian road to Vladivostok, making the distance from London to the Japan sea in 17½ days. After the first few years, when high rates of speed across Siberia are attainable, the trip will be made in nine days.

Travelers to and from the East will prefer to make the journey in eleven days overland to making it, as now, over seas in thirty days. Tickets from Warsaw to Vladivostok are to cost only 120 rubles, first class; from London to Warsaw costs now 150 marks ($35.70). The ticket from London to Vladivostok is to cost about 500 marks ($119), first class; second class is to cost considerably less. A ticket to Japan today via Brindisi and Suez costs 1,800 marks ($428).

That the world is so soon to enjoy trans-Asiatic travel is due to the energetic and successful negotiations of Russian diplomats with the Chinese government. At the beginning of the work the Trans-Baikal and Amur section was planned to extend from Chita, through Sretensk, to Pokrovskaia; thence along the river Amur to Khabarovsk to join the Ussuri railroad, running south to Vladivostok. The construction of this line involved such technical difficulties as would greatly increase the cost of

the undertaking. On investigation it was found that building through Manchuria would not only cheapen and shorten the construction of the road, but would present other advantages. Negotiations were begun, and the Chinese government granted a concession. The Eastern Chinese Railway Company was formed to construct and operate the railway. The articles of association were sanctioned by the Czar, and an imperial ordinance was issued in December, 1896.

The association organized under the convention of August 27, 1896, by the Chinese government, with the Russo-Chinese Government Bank, is to construct and operate a railroad from the western frontier of the province of Heilung Chang to the eastern frontier of Kirin, which is to connect with the Trans-Siberian railway. The company may, with the permission of the Chinese government, engage in coal and other mining, industrial, and commercial enterprises in China. The Russo-Chinese Bank takes upon itself the duty of organizing this company, which acquires the rights and duties granted by the above-mentioned convention. Shares can be held only by Russian and Chinese subjects, and the company will own the Chinese Eastern Railway during eighty years after the opening of the whole line.

The Russian government guarantees the resources of the company to the extent of making obligatory the payment of shares. The company takes upon itself on the part of the Russian government the following obligations: (1) The Chinese Eastern Railway must be always kept in full order to satisfy all the requirements in relation to safety, convenience, and movement of passengers and freights; (2) the traffic on the Chinese Eastern Railway to be kept up in conformity with the traffic on the connecting Russian railroads; (3) all trains of the Russian Trans-Baikal and Ussuri railroads are to be met and forwarded without delay; (4) the company must transmit, with speed not less than that used on the Siberian railway, all passenger and freight trains in direct communication; (5) the company binds itself to construct along its road a telegraph line connecting with the telegraph lines of the Russian railroads, and to promptly receive and send through dispatches to and from Russia and China; (6) if its technical arrangements shall not insure uninterrupted traffic of passengers and freights, then, as the Russian railways require, the Chinese Eastern Railway must take suitable measures to improve its technical arrangements. In case of misun-

derstandings the Chinese Eastern Railway agrees to submit to the decision of the Russian Minister of Finance. If the means of the Chinese Eastern Railway shall not be sufficient to carry out the necessary improvements, the road can apply for pecuniary assistance to the Russian Minister of Finance; (7) maximum passenger, freight, and telegraph tariffs shall be established by agreement between the company and the Russian government, which cannot be raised during the whole period of the concession without the consent of the Russian government; (8) Russian mail packages and officials accompanying the same are to be carried free of charge. For this purpose the company assigns to each passenger train a part of one car. The Russian post-office department may furnish post-cars constructed at its own expense, but the repairing, keeping, and switching of them must be done by the railway company free of charge. After the eighty years' concession has expired the road will pass free to the Chinese government. A sale of the railway does not in any way change the obligations.

The following rights are given by the Chinese government to the railroad company: (1) The passenger baggage and merchandise in transit from one Russian station to another are exempt from all Chinese customs duties, interior taxes, and revenues; (2) the tariffs for passengers, freights, telegraphs, etc., are to be free from all Chinese dues and taxes; (3) merchandise imported and exported to and from China and Russia will pay one-third less than the regular export and import Chinese duty paid at Chinese sea custom-houses; (4) goods imported by rail for the interior shall pay transit duty to the amount of one-half of the import duty, and are free from additional duties.

The company is at liberty to buy its construction materials wherever it sees fit, and materials not purchased in Russia will be free from Russian customs duties. The stock capital is fixed at 5,000,000 paper rubles ($2,570,000), and is divided into 1,000 shares, issued at par. The Russian government does not guarantee these shares. Bonds will be issued in proportion to requirements, subject to the approval of the Russian Minister of Finance. The income and liquidation of these bonds will be guaranteed by the Russian government.

The company is to begin work in August, 1897, and the line is to be completed in six years. The new line will begin at Onon, on the Trans-Baikal Railroad, cross the frontier near Staro-

Zurukhait, run in Manchuria toward the towns of Cicikar (Tsitsikar), Khu-lan-Chen, and Ning-tu, and connect with the Nikolsk station of the South Ussuri Railroad. The total length of the Manchuria railway will be 1,920 versts (1,273 miles), of which 1,425 versts (945 miles) will be in Chinese territory. According to the original survey of the Siberian line, the course through Manchuria will shorten the Siberian railroad 514 versts (341 miles). The Manchuria line traverses a country of better climate and more productive soil. The fruitful valley of the Sungari supplies the Amur region with bread, and northern Manchuria possesses natural wealth, to some extent already worked.

In a recent number of *Jahrbücher für Nationalökonomie und Statistik* there appeared an article by Dr Ballod "Concerning the importance of the husbandry of Siberia." He arrives at the conclusion that the Siberian railway will at first only open up the country for the export of the more valuable classes of goods and facilitate wholesale immigration. It will be of enormous importance as a transit route for goods of high value from China and Japan, and also for passenger traffic from and to these countries, but it will be serviceable to the development of grain export only in a very limited degree. Careful estimates of production and freights convince him that an increased output of grain cannot be expected so long as low prices rule. It would be necessary for the Siberian peasant to export at a lower price than has hitherto been paid for his grain in the home markets. Should prices rise materially, profitable cultivation of wheat in middle Siberia would become a possibility, and this would probably bring about an important increase in exports.

GEOGRAPHIC LITERATURE

Glaciers of North America: A Reading Lesson for Students of Geography and Geology. By Israel C. Russell, Professor of Geology in the University of Michigan. Pp. x + 210, with maps and illustrations. Boston: Ginn & Company. 1897. $1.90.

Professor Russell's prefatory "To the Reader" is a stalwart message. "Strange as it may appear," he says, "in the face of the overshadowing popular interest that centers in the glaciers of the Alps, North America offers more favorable conditions for the study of existing glaciers and of the records of ancient ice sheets than any other continent," for in North America the three great types of glacier—alpine, piedmont, and continental—are magnificently exemplified, while the glaciers of other continents (save little-known Antarctica) are limited to the poor little alpine

type. The type specimen of the piedmont glacier is the Malaspina ice sheet of Alaska, while the type for the vast continental glaciers of the ice age is found in Greenland. "The magnificence of the field for glacial study in North America has only been appreciated within recent years, and is still unrecognized outside of a limited circle of special students," but the recognition must extend under this forcible presentation.

A student of the European Alps and the Southern Alps of New Zealand, both famed for glaciers; the explorer of several glaciers of the high Sierra; the discoverer of Malaspina glacier and the sole student of the ice-fields high on the slopes of Mount St Elias; an experienced investigator of the glacial deposits and glacial history of United States from Atlantic to Pacific, Professor Russell is well qualified to prepare a reading lesson on glaciers, and his experience crops out between the lines on every page. Perhaps half of his admirable pictures are from photographs of his own making, and although the pronoun in the first person seldom appears, a third or a half of the descriptive paragraphs—and these make up most of the book—represent personal work. Thus the chapters have an attractive air of freshness and realness. This strong personal element, which gives the treatise its greatest value, has apparently affected the arrangement of contents, giving the work the form of a narrative rather than the symmetry of a monograph. The first chapter is an introduction, in which definitions and general features are set forth. After enumerating the "leading characteristics of glaciers," the author proceeds thus to answer the question, "What is a glacier?" "As a provisional definition, it may be said that a glacier is an ice body originating from the consolidation of snow in regions where secular accumulation exceeds melting and evaporation, *i. e.*, above the snow line, and flowing to regions where waste exceeds supply, *i. e.*, below the snow line" (page 16). He then describes glacial abrasion, smoothed and striated surfaces not produced by glaciers, special features of glaciated surfaces, glacial deposits, glacial sediments, and changes in topography produced by glaciers, all with less repetition in treatment than in titles. The second chapter relates to the general distribution of the glaciers of North America, and then follow five chapters devoted respectively to the glaciers of the Sierra Nevada, the glaciers of northern California and the Cascade mountains, the glaciers of Canada, the glaciers of Alaska, and the glaciers in the Greenland region, these chapters containing more than half the volume and most of the value of the book. There is a chapter on the climatic changes indicated by the glaciers of the Ice Age and another on the movement of glaciers, while the tenth and last chapter is a suggestive and attractive discussion of the life history of a glacier, in which the extended observations and reflections of the author are summarized.

The strong points of the work are its vividness and trustworthiness; the arrangement might have been improved, a few trifling errors in the orthography of names might have been corrected, and the general scientific discussion might have been strengthened, but teachers and others are to be congratulated on having at last—and for the first—a thoroughly reliable popular account of the glaciers of North America.

W J M.

A Treatise on Rocks, Rock-Weathering, and Soils. By George P. Merrill, Curator of Geology in the National Museum, etc. Pp. xx + 411, with numerous illustrations. New York: The Macmillan Company. 1897. $4.00, net.

During the present generation a score of students in this and other countries have turned attention to the soil; and, while it may be questioned whether they have yet succeeded in organizing a science of the soil, it may be affirmed that they have made substantial contributions toward such a science. Hitherto most of the publications pertaining to the subject have been technical or at least special, and confined to official documents; but now comes Professor Merrill, already favorably known through professorial work and general writing, with a popular work on soils adapted to both class work and general reading. His apology for the publication—"It is believed that no apology is necessary even in this day of many books for bringing out the present work"—emphasizes the importance of the subject: Human life and the ancillary animal and vegetal life of the land depends on the soil; the fullness of the earth is its wealth in soil; and the worthiest science—albeit in very infancy yet—is that pertaining to this richest of all natural resources. Every student, every teacher, every citizen, every statesman, ought to welcome such a contribution to human progress as this useful treatise.

The work is arranged in five parts, each divided into several chapterlets. In the first part rocks are discussed as to their constituents, their physical and chemical properties, and their modes of occurrence, and in the second they are classified as (1) igneous, (2) aqueous, (3) æolian, and (4) metamorphic; thus this part of the work deals with rock-making, and sets forth the laws involved in the development of the fundamental constituents of the external earth. The next two parts are devoted, respectively, to the weathering of rocks and to the transportation and redeposition of rock debris, and in them the unmaking and remaking of rocks are admirably though briefly expounded. Part V, in which the originality of the work is concentrated, is entitled "The Regolith;" under this new term (derived from Greek words for *blanket* and *stone*) the unconsolidated material mantling the hard rocks is discussed in detail. The warrant for introducing a new word for the soils, subsoils, and other superficial materials of the earth arises in daily need; several terms have already been employed—"soil," "earth," etc., in general, "drift," "diluvium," "alluvium," etc., for transported material, and "residua," "terra rossa," "gruss," "geest," "saprodite," etc., for the products of rock decay—among laymen and scholars, but none has thus far proved satisfactory. Merrill's suggestion is better than any that has gone before, but it remains to be seen whether his term will survive or fall into the ever-yawning grave of desuetude. The author proceeds to classify the regolith as (1) sedentary and (2) transported; the former is subclassed as (*a*) residual deposits and (*b*) cumulose deposits, while the latter is divided into (*a*) colluvial deposits, (*b*) alluvial deposits, (*c*) æolian deposits, and (*d*) glacial deposits. In addition, the soil proper is described, as a product rather than a deposit, with respect to chemical composition, mineral constitution, and physical condition, as well as with respect to weight, color,

and age. The great complexity of the soil is adequately recognized, and the multifarious interactions between the chemical, physical, and vital, by which the soil is produced and modified, are set forth appreciatively.

In treatment as in subject, Professor Merrill's work is notable. It is strictly up-to-date, embracing the results of the latest researches, and duly recognizing the work of contemporary investigators; also it is made admirable mechanically by clear typography, good paper, excellent illustrations (many of them photomechanical reproductions), and a full index.

W J M.

GEOGRAPHIC SERIALS

The Geographical Journal for March opens with the minutes of the Nansen meeting in London. Messrs Munro and Anthony continue the narrative of their explorations in Mysia. Dr Dawson summarizes the progress of the geographical work of the Geological Survey of Canada for the past year. Mr Vaughan Cornish furnishes an exhaustive article on the Formation of Sand-dunes, and Professor Leo Reinisch an article on Egypt and Abyssinia.

The Scottish Geographical Magazine for March opens with an article entitled "Cape Juby," by Mr Fred S. Zaytoun, which contains a quite full description of the northwestern part of the Sahara. Mr John Murray has an article on the Balfour Shoal, a submarine formation in the Coral sea, in the southwestern Pacific. This is accompanied by a chart and profile showing temperatures of the sea water. The Nansen expedition receives further notice in the form of a review of Dr Nansen's book.

The Royal Colonial Institute, of London, is an organization for the increase and diffusion of knowledge relating to Great Britain and her dependencies. Its purpose, as stated in its by-laws, is "to provide a place of meeting for all gentlemen connected with the Colonies and British India, and others taking an interest in Colonial and Indian affairs; to establish a reading-room and library, in which recent and authentic intelligence upon Colonial and Indian subjects may be constantly available, and a museum for the collection and exhibition of Colonial and Indian productions; to facilitate interchange of experiences among persons representing all the dependencies of Great Britain; to afford opportunity for the reading of papers and for holding discussions upon Colonial and Indian subjects generally, and to undertake scientific, literary, and statistical investigations in connection with the British empire."

The Institute publishes a journal, which has already reached its twenty-eighth volume, the first four numbers of which have been issued. The character of its work may perhaps be illustrated by an enumeration of the principal papers contained in these recent numbers of the journal. Part I contains "Inter-British Trade," by Mr John Lowles, and "The Colony of Victoria; Some of its Industries," by E. Gerome Dyer. Part II contains an article by Sir Henry H. Johnston, entitled "England's Work in Central Africa," in which the recent progress of civilization in Great Britain's share of that continent is admirably summarized. Mr

E. Burney Young has an article entitled "The Colonial Producer." Part III contains an article by Sir Sidney Shippard on the Administration of Justice in South Africa, and one entitled "Cyprus and Its Possibilities," by Charles Christian. Part IV pictures the economic condition of Australia at the present time, under the title "Studies in Australia in 1896," by Hon. T. A. Brassey. H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Special Meeting, March 15, 1897.—Third Monday afternoon illustrated lecture. Vice-President Greely in the chair. Rev. Thomas J. Shahan, LL. D., Professor in the Catholic University of America, lectured on Syria.

Regular Meeting, March 19, 1897.—Vice-President Merriam in the chair. Mr Arthur P. Davis, of the U. S. Geological Survey, read a paper on "The Deserts of Southern Arizona and How They Are Redeemed by Irrigation," illustrating his subject with lantern slides.

Special Meeting, March 22, 1897.—Fourth Monday afternoon illustrated lecture. President Hubbard in the chair. Prof. Thomas Davidson, M. A., of Aberdeen, Scotland, lectured on Tyre and Sidon.

Annual Reception, March 25, 1897.—The Annual Reception of the Society was held at the Arlington Hotel, from 9 to 12 o'clock p. m. President Hubbard, with the ladies of the Reception Committee, received the members and guests of the Society, to the number of 300. The Society was honored with the presence of the President of the United States and several members of the Cabinet.

Special Meeting, March 26, 1897.—President Hubbard in the chair. Hon. John W. Foster read a paper on the Hawaiian islands. A number of maps were shown on the screen at the commencement of the lecture, and at its close Mr E. D. Preston, of the U. S. Coast and Geodetic Survey, exhibited a series of lantern-slide views of scenery in the islands.

ELECTIONS.—New members have been elected as follows:

March 19.—D. Q. Abbot, Mrs Emily E. Briggs, Paul Brockett, Rev. S. Bayard Dod, Prof. L. M. Drake, A. F. Dunnington, Miss C. L. Freethey, Prof. H. G. Hipp, S. B. Laird, Col. J. R. Lewis, U. S. A., George B. Magrath, V. F. Marsters, Miss Hester McNully, Miss Annie S. Peck, Dr Fred L. Ransome, Miss Olive R. Seward, J. C. Stanton, C. E.

At a meeting of the Royal Geographical Society held in London on March 22 Dr Nansen expressed his conviction that a properly equipped expedition could now reach the Pole in a single summer. He stated, however, that from a scientific point of view the results of such an expedition would be of far less value than those of some other explorations that might be undertaken in the less known parts of the Arctic regions.

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By PROF. B. E. FERNOW, PH. D.,

CHIEF OF THE DIVISION OF FORESTRY, U. S. DEPARTMENT OF AGRICULTURE;

Costa Rica,

By GENERAL RICHARD VILLAFRANCA,

CONSUL-GENERAL OF COSTA RICA AT SAN JOSE, GUATEMALA, EX-COMMISSIONER TO THE WORLD'S COLUMBIAN EXPOSITION;

Prehistoric Man the Product of Geographic Environment,

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PRESIDENT OF THE NATIONAL GEOGRAPHIC SOCIETY,

—— AND ——

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